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A study of the nature, product, expenses, and income of a university develops a methodology to translate a university's statement of these descriptive data into an analytical cost study framework. The product of a university is defined as the intellectual growth of students and staff. Since this product can not be quantified, costs are assigned to class units (meetings of students and teacher) which are proxy variables representing the product. Information requirements for the construction of total cost schedules relating to the degree-granting process are formulated and examples are given. Methods for allocating and distributing direct and indirect expanses and revenues are analyzed within the cost model framework. By introducing the concept of marginal cost functions into the framework it becomes possible to base predictions of fiscal requirements on each institution's unique policies and practices. Implications of this procedure are examined to show how the data can be transformed into useful studies of (1) factors influencing the cost of classes, (2) estimation of future expenses based upon changing student population, and (3) institutional or interinstitutional per student cost comparisons. (TT)

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Some Economic Considerations and a Procedure for a University Cost Study

by

Harry H. Hirschl

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SOME ECONOMIC CONSIDERATIONS AND A PROCEDURE FOR A UNIVERSITY COST STUDY,

A Thesis

Submitted to the Faculty

of

Purdue University

by

Harry Hamel Hirschl

In Partial Fulfillment of the

Requirements for the Degree

of

Master of Science

June, 1965

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This thesis is a product of my eight years' experience in university administration working under the leadership of many talented persons, especially Wesley Arden and James F. Blakesley. My price theory teacher and the major professor under which this thesis was written, Professor J. W. Wiley, has given encouragement and careful review of all aspects of this work. Professor J. W. Hicks, a member of my committee and a leader in the development of university cost analysis, has given many hours of thoughtful assistance with unfailing good humor and brilliant insight. Professor J. A. Papke, the third member of my committee, contributed a careful reading of the first draft of this manuscript, giving valuable suggestions to improve the clarity of expression and discovering several errors in the logic.

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TABLE OF CONTENTS

		Page
	LIST OF TABLES	iv
	LIST OF ILLUSTRATIONS	v
	ABSTRACT	vi
I.	INTRODUCTION	1
	Definition of the Processes	3
	The Degree Process	4
	The Conference and Correspondence Process	4
	The Field Service Process	5
II.	THE ECONOMIC FRAMEWORK OF "THE DEGREE PROCESS"	6
	Description of the Production Function	6
	Average and Marginal Costs	10
	Policy Implications from the Cost Analysis	10
	A Further Marginal Concept	13
	Discussion of the Class Size Policy	14
	Non-Laboratory Classes	14
	Laboratory Classes	17
	Thesis Research	17
	Final Cost Considerations	17
III.	THE COST STUDY PROCEDURE	19
	Overview of the Data Requirements	19
	Expense	20
	Income	21
	Developing the Direct Costs	22
	Developing the Indirect Costs	37
IV.	THE SIGNIFICANCE OF THE COST STUDY PROCEDURE	50
	Analysis of the "Building Blocks"	50
	Development of the Simulation Model from the Cost Computations	52
	Ultimate Use of the Simulation Model	56
	Conclusion	57
	BIBLIOGRAPHY	60

LIST OF TABLES

Table		Page
1.	1962-63 Registration Report	24
2.	Course Enrollment Report.	25
3.	Departmental Report on Staff & Space Assignments. . . .	26
4.	Illustration of Class Teaching Requirements	28
5.	Computing the Salary Expense for Staff Assignments. . .	34
6.	Partial Listing of Chemistry Courses for First Semester 1962-63.	35
7.	1962-63 Income & Expense Statement Aeronautics & Engineering Sciences.	42
8.	1962-63 Income & Expense Satatement for 193 Students in Electrical Engineering.	46
9.	Purdue University 1962-63 Cost Study.	48

LIST OF ILLUSTRATIONS

Figure		Page
1.	Production Function for "The Degree Process".	7
2.	Average & Marginal Cost Curves	11
3.	Relationship between Number of Students and Number of Classes.	16
4.	Service Report for an Associate Professor in the Department of Electrical Engineering.	30
5.	Service Report for an Instructor in the Department of Modern Languages	31
6.	Service Report for a Graduate Assistant in the Department of Chemistry	32
7.	Schematic Diagram of the Indirect Expenses Allocations.	39
8.	Relationship between Marginal & Variable Cost	55

ABSTRACT

Hirschl, Harry Hamel, M. S., Purdue University, June 1965. Some Economic Considerations and a Procedure for a University Cost Study. Major Professor: Jay W. Wiley.

The research of this thesis is an inquiry into the economics of a university. This inquiry examines the nature, product, expenses, and income of a university so that all can be inter-related to develop an analytical frame of reference. The approach is micro-analytical, describing how any one university might analyze its operations. Following is a summary of this examination:

1. The nature of a university is an environment for learning.
2. The product is the intellectual growth of those who participate in the environment, namely students and staff.
3. This product is essentially intellectual, and therefore it can not be quantified.
4. Instead of assigning the costs directly to the product, they are assigned to a quantity that represents the product.
5. The quantity used in this analysis is the class, defined as the meeting of students and teacher.
6. It was found that three types of students can be served by a university, thus requiring that the environment for learning and the classes be separated into three processes:
    a. The Degree Process

b. The Conference & Correspondence Process

c. The Field Service Process

7. The major emphasis of this thesis is on an analysis of "The Degree Process".

Next a procedure consistent with these concepts and relationships is presented. This procedure shows in detail how student, teacher, and fiscal data can be united in "The Degree Process". The total cost of 'The Degree Process" is constructed by combining the costs of the smallest economic units, the classes. This approach requires that information about each student be available in terms of his field of study and level. Student level refers to freshmen, sophomore, junior, or senior if descriptive of undergraduate students; it defines whether or not the student is enrolled in courses or doing his thesis research if descriptive of graduate students. The required data for the teachers are the terms of employment (full or part time), salary, and participation in the fringe benefits of the university. The assignments of teachers to classes and the assignments of duties to teachers are also required. Fiscal information on income and expense is necessary, on an accrual basis, so that data pertaining to the operating period under study are related to the production. The operating period is defined as a semester, quarter, or session with a fiscal year being composed of several operating periods. The exact combination of operating periods is dependent on the university's system: semester, quarter, or trimester. The procedure describes a methodology for allocating and distributing both the direct and indirect expenses.

Finally the implications of this procedure are examined to show how the data can be transformed into a number of useful studies of

both present and future operations. Included in this topic are the following:

1. An examination of the factors that influence the cost of the classes;
2. A presentation of a model for simulating the operations of an environment for learning, showing how future expenses can be estimated based on a changing student population;
3. A discussion of per-student cost comparisons either intra-institutionally or inter-institutionally, based on the shape of the production functions of the units being compared.

I. INTRODUCTION

Once of society's most pressing problems today is financing higher education. Additional funds are required for the training of increasing numbers of students, but both the literature on financing higher education and present accounting practices of universities are barren when the social scientists, prospective donors, or governmental agencies try to measure these needs in quantitative terms. The following views are representative of the present state of affairs:

> "The financial problems of higher education... are considerably complicated by a lack of adequate systems of accounts, budgets, operating data, planning technique, and general budgetary disciplines..."[1]

> "Our institutions teach accounting yet many of them have second rate bookkeepers and inadequate accounting systems. Often cost accounting is a part of the curriculum but the educational administrator would not conceive of utilizing it in connection with his work."[2]

The objective of this work is two-fold;

1. To develop a methodology capable of translating a university's statement of income and expense and other descriptive data into an analytical framework; and
2. To introduce the concepts of marginal cost functions into the framework so that predictions of fiscal requirements are

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[1] "An Economist's Overview", Phillip H. Combs, Financing Higher Education 1960-70, McGraw-Hill, New York, 1959, p. 22.

[2] "A State Official Speaks Up", Edward J. Bolling, College and University Business, McGraw-Hill, New York, November 1960, Volume 29, No. 5, p. 55.

based on each institution's unique policies and practices.

These objectives necessitate a publication that has both the characteristics of a Book of Principles and a Manual of Instructions.

The approach to the problem is micro-analytical, that is, it focuses on what a single university might do to anticipate its fiscal requirements. A macro-analytic or aggregative approach, on the other hand would concentrate on estimating the future needs of higher education for the United States. Professor Seymour E. Harris's recent contribution probably best typifies the latter approach.[3]

The first requirement for this task is to have a workable definition of a university. One such definition is provided by President Kerr of the University of California.[4]

He gives us a key to an economic analysis when he defines a university as "... a mechanism - a series of processes producing a series of results - a mechanism held together by administrative rules and powered by money."[5] These processes are essentially intellectual and the product is knowledge. As a consequence, the output does not lend itself to quantification. An economic analysis, however, is an abstraction, and as such need not literally be descriptive of the processes. The fundamental requirement is that the analysis illustrate the economic factors at work in the activity and show how each factor interacts with all others to produce the process. Instead of invest-

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3 Higher Education: Resources and Finance, Seymour E. Harris, McGraw-Hill, New York, 1962.

4 The Uses of the University, Clark Kerr, Harvard University Press, Cambridge, 1962.

5 Ibid, p. 20.

igating the physical or human output of a university, a much more satisfactory approach is to analyze the input factors for the environment that produces this output, omitting any value judgments about the quality of the environment or the quality of the physical or human output.

A university encompasses a diverse array of activities: besides doing teaching and research, it operates car pools, presses for publishing books and journals, hotels, clinics for every conceivable ailment of man and beast, residence halls, cafeterias, machine shops, computing centers, and programs for entertaining alumni, students, and staff. This description can serve as a point of departure. All that is needed for an analysis is a frame of reference that takes into account all these activities.

Definition of the Processes

Because of the nature of a university, teaching and research are the central activities of all the processes. Other activities, in one way or another, are implementary to teaching and research although admittedly some of them are quite remotely related. That is to say, students are involved in all processes of a university. If an activity is not part of teaching and research, or not implementary to them, or does not involve students, then it must be separately categorized and analyzed. Specifically excluded on these grounds are "research institutes" that conduct research for non-university organizations, with a professional staff that is not involved with supervising graduate students. Also excluded are the so-called "public service" aspects of activities related to teaching and research. This public service, most commonly found in clinics, represents a residual of both income

and expense which cannot be imputed to teaching and research, and therefore is outside the framework that will be discussed in this thesis.

The students in the university environment are participants, not products, and the number and classification of these students have an effect on the costs of the environment as will be shown.

Three basic processes of the university environment can be identified.

The Degree Process

This process involves students registered in a field of study leading to a degree or certificate with the degree objective being reached when the students have satisfactorily completed a series of courses. Normally two years are required for completion of courses required for a certificate, four years for completion of the requirements for a baccalaurate degree. Additional years and courses beyond those required for a baccalaurate degree are required for a master's or doctorate degree.

The Conference and Correspondence Process

This process involves students who register for a specific class or set of classes, usually conducted intensively for a period of weeks. Students in these programs do not receive a degree or certificate corresponding to those given in "The Degree Process". Other titles for these activities are Adult Education or Continuation Services. Conference students normally come to the campus for instruction while correspondence students usually work at home.

The Field Service Process

This process involves students who have highly specialized interests. The teacher usually goes to them instead of having the students come to the campus. Agricultural extension is probably the most common example of this process, although there are others.

This thesis will devote itself almost completely to the analysis of "The Degree Process". The plan of the work is to set forth an analytical framework in Chapter II, lay out the detailed cost analysis procedure in Chapter III, and discuss some of the implications of the procedure in Chapter IV.

The examples and illustrations came from Purdue University's cost study of the 1962-63 fiscal year. The procedure has been developed during the past ten years with the writer's effort having been added to the contribution of others[6] here.

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6 Prof. John W. Hicks and Mr. Wesley Arden.

II. THE ECONOMIC FRAMEWORK OF "THE DEGREE PROCESS"

The purpose of this chapter is to set forth the economic framework in which "The Degree Process" will be considered. This framework then will become, in the next chapter, the model upon which the analysis of student, staff, and financial data will be erected. By analyzing "The Degree Process" in this manner, it is possible to determine which data are relevant and how they may be utilized in analyses and projections.

The following assumptions begin the development of this framework.

1. The university's primary product is the intellectual development of those who participate in "The Degree Process", namely students and teachers. In other words the central activity of the university is teaching and research.
2. Since this product is intellectual, it is impossible to quantify the output directly. Instead the costs are assigned to units that represent the output.
3. The unit chosen for this analysis is the class, defined as a meeting of students and teachers.
4. The production function of a university is expressed as a relationship between the number of classes and related expenses. Figure 1 portrays graphically the functional relationship.

Description of the Production Function

Figure 1 is illustrative of the production function of "The Degree

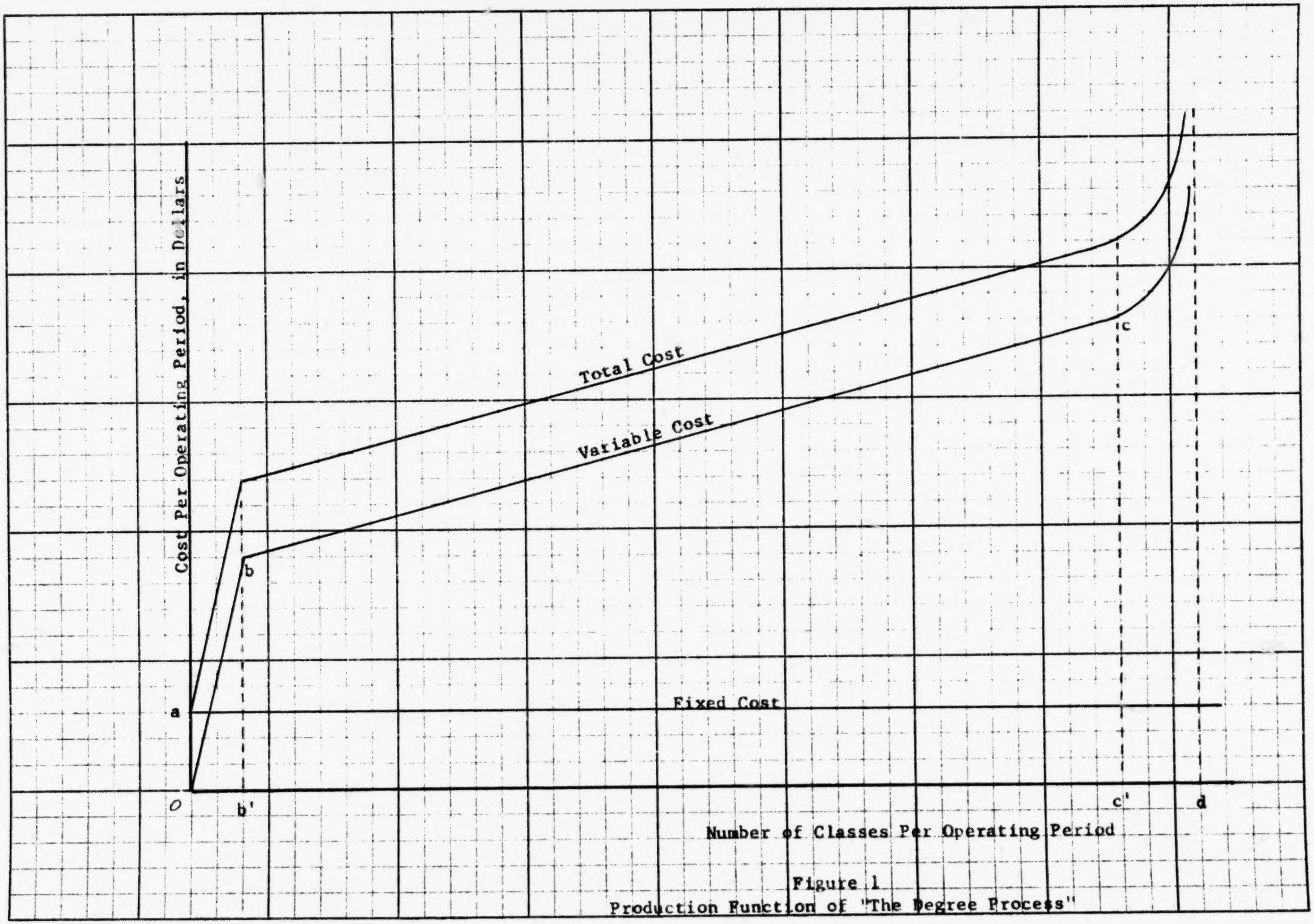

Figure 1
Production Function of "The Degree Process"

Process". The operating period refers to a semester, quarter, or other length of time in which students and staff are organized for a series of classes. There are four operating periods in a fiscal year for a university on the quarter system. There are three operating periods in a fiscal year for a university operating on a semester system: two semesters of equal length plus a summer session. The tri-mester system also has three operating periods in a fiscal year, but they are of equal length.

The distance 0-a in Figure 1 represents the fixed costs which are incurred whether or not there are any classes being offered.

Point b represents that level of variable cost and output which is necessary to start operations. Several classes are the least number that a university can offer for the smallest possible number of students in "The Degree Process", given the fact that each student enrolls in several classes each operating period. The line 0-b has a fictitious quality, since it is not possible to have any production less than b'.

The line b-c represents the usual operating range for a university, and the slope of this line is dependent upon the classification of students anticipated in the planning period. If the classes are to be offered for undergraduate students, the slope will be rather gentle. If, on the other hand, the classes are for graduate students, the slope will be much steeper.

The three most important factors that influence the variable cost for a class are (1) the salary of the teacher, (2) the time needed to teach the class and (3) other variable supplies or expense items. In general graduate classes have higher costs than undergraduate because the teachers of these classes have higher salaries, they need more time

to prepare for teaching, and more expensive items are required. In general, therefore, each class for graduate students is more costly than for undergraduate students.

The distance 0-d (Figure 1) represents the maximum number of classes that can be offered in the planning period under study. In order to reach this maximum, classes would probably have to be offered at night causing an increase in utility expense. The classes would probably be taught by part-time staff who would need an extra salary inducement to teach them. Thus variable costs would rise as the output approached d. This condition is indicated in Figure 1 by the up-turn in the variable cost curve beyond point c.

The components of variable cost include all labor and supplies directly assigned to the output with the understanding that the quantity of both can be adjusted to production requirements within the planning period. Since most of the staff members in a university have tenure, there is some question about calling the salary expense for these staff members a variable cost. Clearly their time and salary expense are assignable to classes, as will be shown.

It must be realized, however, that a university is a continuing activity. There will always, therefore, be a demand for the staff members' services. The variable quantities are the marginal cases; that is, an extra staff member may or may not be hired depending on the expected need for additional classes or alternatively a part-time teacher is added for one or more classes that are necessary but unforseen. It appears that the term "variable cost" can be applied to the staff members who have tenure, though it is clearly not the parallel of a profit-seeking enterprise. Even in the latter case, long-term labor

contracts, esculator clauses, quaranteed annual wages, and the like remove some of the variable character of labor.

Average and Marginal Costs

Figure 2 is derived from Figure 1. Only the average variable and marginal cost curves have been drawn, since the average total cost curve will have the same characteristics as the variable (though it will not be parallel to the average).

Again the distance b'-c' represents the usual operating range, and the shape of the average variable cost curve between these two points is dependent on the slope of b-c in Figure 1. The marginal cost curve is a horizontal straight line because the rate of change of cost with respect to classes is constant throughout the b'-c' range.

The reason the average variable costs decline while the marginal costs remain constant is related to the relative magnitude of the two costs at any level of output in the b'-c' range; the marginal costs are significantly less than the average at b', after which the difference becomes less and the two curves approach each other and become equal at c'. To the right of c', both average and marginal variable costs rise with marginal rising much faster than average. The reason for this reversal of the position in the two curves is the fact that marginal costs have had to become larger than average costs to induce the upturn to the right of c'.

Policy Implications from the Cost Analysis

The purpose of production functions and the average/marginal concepts is to give an insight into the cost-output relationships of an activity; that is, to describe the effects of changing the level

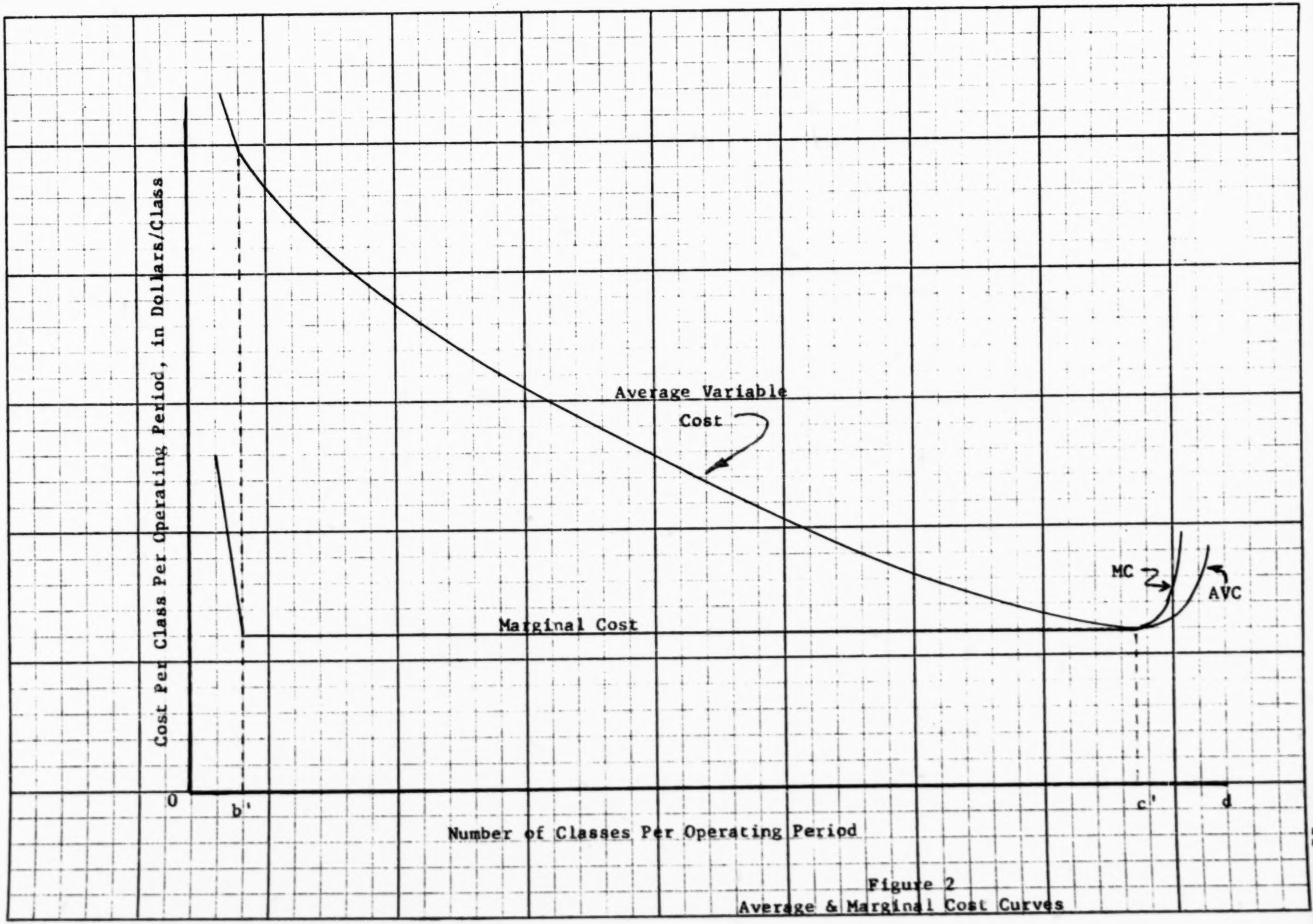

Figure 2
Average & Marginal Cost Curves

of output given the size of plant and the costs of the factors of production. The ideas are all related to planning a present and future course of action.

The foregoing statements have been concerned exclusively with the costs of production, ignoring an analysis of income. In a profit seeking enterprise, the quantity of output for maximizing profit considers both the costs of production and the income resulting from the sale of the product. On the other hand, a university is a non-profit-making activity. A minimization of costs, ceteris paribus, is desirable since both income from student fees and the other sources will then be minimal and education offered at the lowest possible cost. There is no need to have an income greater than expenses for a non-profit activity.

One of the ways to minimize costs is to have enough excess capacity in the physical plant so that the number of classes does not exceed the point at which the minimum average cost per class is reached. It seems desirable, however, to have the operations approach the minimum cost per class; an increase in efficiency (as measured by the ratio of the actual cost per class to the minimum cost per class) can be brought about by increasing the number of classes to c'.

Further, the analysis illustrates the need for careful planning of both plant and operations, such that the 0-c' is nearly equal to 0-d'. For example, a university may have sufficient classroom and laboratory space to double the number of classes, but there is insufficient office space to house the additional staff members. If the decision is made to expand operations to the maximum, additional funds will be needed to balance the amount of space devoted to classrooms,

laboratories, and office space because of improper planning. The alternative is to increase the costs of operations by renting space (or using space that is unusually expensive to maintain, if available) and permanently operating in the c'-d range.

This apparatus also provides guide lines for the long-range planning of the proper size of a university. Assuming correct planning of the physical plant, the implications are that a university can grow indefinitely from a study purely of the economics-of-operations. It may be that dis-economies of size exist in the management costs, but this condition can only be observed and not forecast.

A Further Marginal Concept

The fact that the number of classes is not directly related to the number of students leads to a further marginal concept, different from the one discussed previously. This is an expression of the in-divisibility-of-factors (or "lumpiness") problem with which economists are familiar. Its application can be illustrated by examining Table 8, "1962-63 Income & Expense Statement", which shows a total course expense of $82,990 or $430 per student on the average for Electrical Engineering students in one semester of their sophomore year. This other marginal analysis can be investigated when the answer is sought to the question, "What would the cost have been if there were 200 students instead of 193?" Obviously the per student cost would decrease (by 7 x $82,990/200 x 193) if the total course expense remains the same. For the total course expense to remain the same requires that the classes already in existence absorb these seven additional students without any more classes being formed. If the seven students caused an increase in the number of

classes, then the magnitude of the increase in the total course expense will depend on which specific classes were added. In order to determine whether or not additional classes must be formed, it is necessary to examine whether or not excess capacity exists in the classes being offered. This question then raises the issue of the class size policy (for a specified percentage of a full-time staff members' time) that is appropriate for the various types of classes.

Discussion of the Class Size Policy

The class size policy is a subjective judgment that is made by each department that offers classes. While the judgment is subjective, there are certain factors that are usually considered when the policy is decided. They are listed below. From the point of view of this analysis, this is a fixed policy which can be stated in various ways, as will be shown.

There are three general types of classes: non-laboratory, laboratory, and thesis research. It is necessary to treat each separately, because they have special characteristics which are directly related to the class size policy.

Non-Laboratory Classes

The class size policy for this type of class is dependent on how frequently the teacher must review the written work or personally interview the students, how important class discussion is for the learning process to be fully exploited, and what other personnel or devices can be employed to assist the teacher either during or outside the meeting of the class. The amount of time required for class preparation is independent as far as the class size policy is concerned.

Each course and class theoretically has a unique size, expressed as a flexible quantity (e.g., any number of students up to 250) or an inflexible quantity (e.g., 20 students is the absolute maximum; if 21 students enroll, two classes must be formed). Another way of viewing this issue is to separate these classes into (a) a "large" class and (b) a "small" class to consider the importance of the staff time per student.

(a) A "large" class, approximately 50 or more students. The opportunity to conduct a class of this size means that the staff time per student is not a quantity that is important. This consideration does not imply that the teacher is not important or any teacher will do, but the issue is that the lecturer's impact can be divided up among n number of students without seriously diminishing the value of the material being presented.

(b) A "small" class, less than 50 students. A class that must be small has the requirement that the teacher's impact is important in relatively large (but perhaps unmeasurable) quantities per student. Why this is true is related to the factors listed above.

Figure 3 has been prepared to illustrate the relationship between numbers of students and numbers of classes based on a flexible class size policy. The assumption is that 20 students per class is "best" but up to 30 students will be acceptable. If 31 students enroll in the course, two classes will be required under this policy.

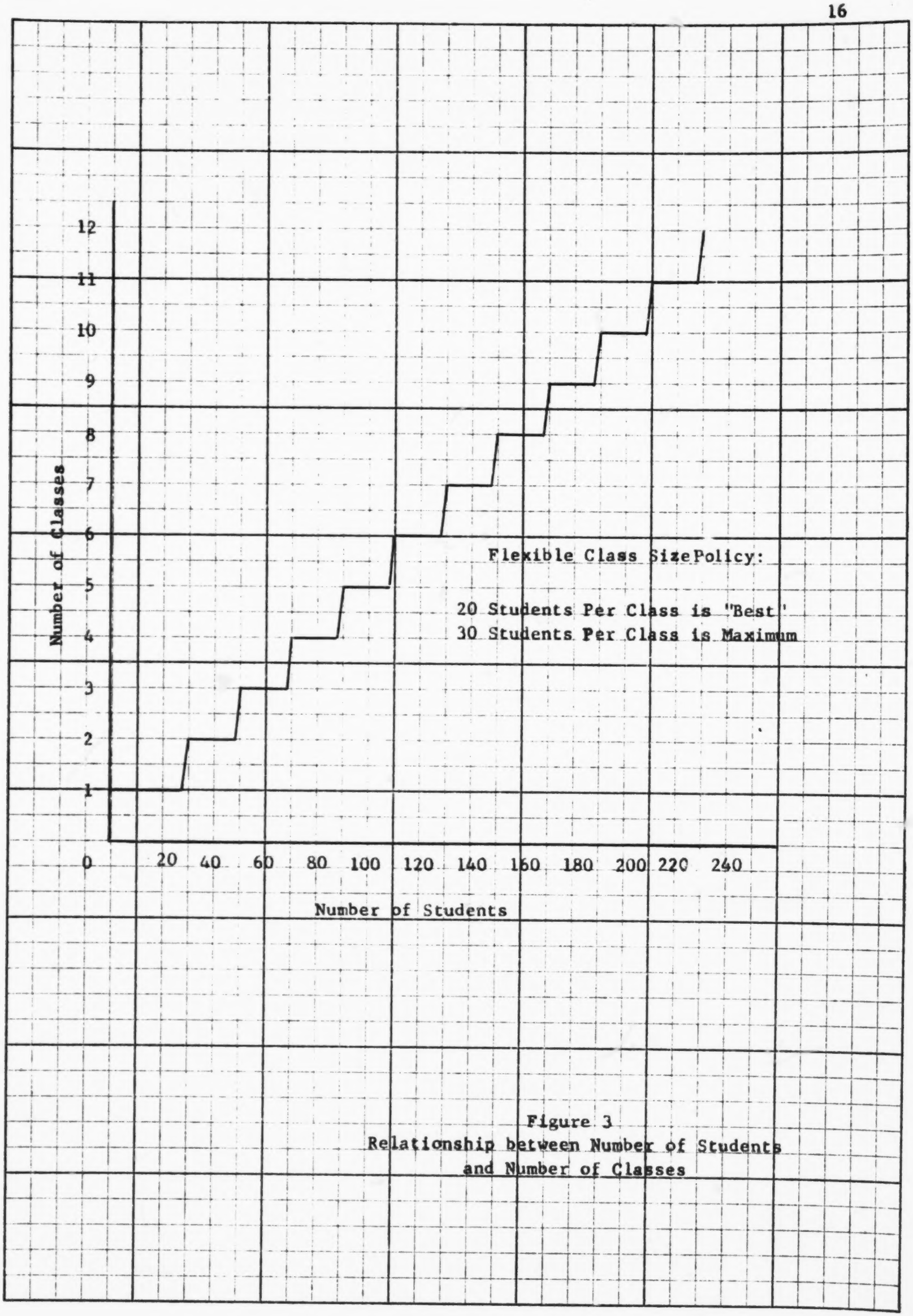

Figure 3
Relationship between Number of Students and Number of Classes

Laboratory Classes

In general laboratory classes are offered to give students a specialized type of manual training or practical experience. These classes usually have a low class size policy (10 to 20 students per teacher) in order to produce safely and effectively the desired result.

Thesis Research

In general research in universities is sponsored by the government, federal or state, or private companies. The supervisors (teachers) of students doing thesis research, therefore, must spend a significant amount of time with these sponsors becoming acquainted with their research problems. In addition, the supervision of the thesis research itself is labor-intensive, requiring time-consuming direction of the research and review of the thesis. Both of these considerations imply that any one staff member who is qualified to supervise thesis research can only be assigned a small number of students. An increase in the number of students, therefore, requires a substantial increase in staff time and concomitant expense.

The question then of which additional classes (if any) have to be created can only be answered by considering the impact these seven Electrical Engineering students will have on the courses they select. The marginal cost could be anywhere from zero to the cost of adding one class in each course involved.

Final Cost Considerations

The cost implications of class size policy are an extension of the cost-per-class subject. It was treated separately for purposes of exposition only. This approach permits an analysis that determines

whether or not the level of operations is at a minimum from a cost per class point of view, and then recognizes that additional students in a class can still further reduce the average course expense per student. Cost centers are the students classified in their field of study and level, and all expenses must ultimately be related to them.

The marginal costs involved in the class size consideration are not as readily computed as those in the cost-per-class apparatus. A simulation model of a university is required to give answers in quantitative terms. This model can be constructed from data about each course and class, including the variable cost factors and the class size policy. Into this model are introduced varying estimates of the number of students by field of study. The output will then give costs in relation to some base operating period. The changing student mix will produce costs that can guide admissions policy, student fee policy, and show the growth of the various departments in terms of staff time, salary expense and the other variable costs.

III. THE COST STUDY PROCEDURE

In Chapter II a basic framework for analyzing the cost of "The Degree Process" has been set forth. In this chapter the details of a cost procedure consistent with that framework will be presented.

The cost procedure is designed to allow maximum flexibility with respect to the use of the data. Essentially the approach is to examine the basic physical unit, the class, and use it as a "building block"[7] to construct the costs of the environment for learning. Development of the "building blocks" first in physical terms and then in cost or dollar terms permits analysis of the costs of the environment under varying price levels, policy changes, or numbers of students. Thus the data developed may be used in prediction and analysis rather than merely in reporting historical costs. The methodology also permits accumulation of historical data by course, by fields of study, or in any other way that may be desirable. While one report from the cost analysis may well be the computation of an over-all "cost per student by level", that report is only one of a multitude of sets of data which may be compiled.

Overview of the Data Requirements

The analysis requires that there be at least seven general categories of expense and five of income. The classification generally

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[7] "Making the Best of Limited Resources", J. W. Hicks, College & University Business, McGraw-Hill, New York, Volume 23, Number 6, December 1957.

follows the outline established by the American Council on Education.[8]

Expense

1. General University Administration & Expense
2. General University Expense Implementary to Students
3. Departmental Expenses for Administration, Teaching, & Research
4. Physical Plant Expenses
5. Library Expenses
6. Expenses for Activities Related to Teaching & Research
7. Expenses for Auxiliary Enterprises

The category entitled "Activities Related to Teaching & Research" refers to any activity that is separately organized to serve both teaching and research. Examples of these activities are Computing Centers, Psychological Clinics, Creameries, and others of a like nature. It may be a large organization with a full set of accounts: assets, liabilities, fund balances, income, and expense. Or it may be a small, almost informal, activity to which several staff members are assigned duties. In either case the expenses of these activities ideally should be represented in the analysis by charges for the services they perform, either to teaching or research, based on a separate analysis of income and expense. This ideal may not be satisfied in all cases. It sometimes becomes necessary to determine entries for any expenses not already charged and then to add this expense either to teaching or to research. The "Auxiliary Enterprises" in most universities are supported by dedicated student fees or other income which offset the expense, and therefore they will not be analyzed.

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8 Volume One, College & University Business Administration, American Council on Education, Washington, D. C., 1952.

1. Student Fees
2. Governmental Appropriations
3. Endowment Income
4. Miscellaneous Income
5. Departmental Income

An analysis of the student fee income is a necessary part of the cost study. It is difficult to make any general statements about governmental and endowment income, as the importance, and therefore relative magnitude, of these two categories is related to the type of institution - public or private. These two income categories are the supplements to student fees that society contributes to higher education. This procedure will illustrate the general principle involved in the analysis. Miscellaneous and departmental income presumably represent off-sets to various categories of expenses and therefore can be credited to them.

The information on income and expense should be established on an accrual basis so that the figures represent actual conditions for the period under study. Accrual accounting is the minimal requirement for fiscal data; the ideal would consist of an accounting methodology that parallels what is called "volume-cost analysis" or "variable budgeting" in an industrial enterprise.[10] Accrual and volume-cost accounting are designed to relate fiscal and production data. Only when these two are correlated will it be possible to have accurate information on income and expense in any operating period.

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[9] Ibid

[10] Profit Planning through Volume-Cost Analysis, J. Y. D. Tse, The MacMillan Company, New York, 1960.

Depreciation of buildings and equipment should be included also in order to show the costs of utilizing these assets on an annual basis. In most institutions this information is not available, but if it were, the appropriate charges would be expressed in the study.

In addition to the annual financial data, it is necessary to have statistical data for each student registered in "The Degree Process" in the operating periods under study, reporting the student's field of study, level, and the courses selected. "Student level" refers to freshman, sophomore, junior, or senior if an undergraduate. The graduate level is divided into two categories of students: those taking courses exclusively and those working on their thesis research. Payroll data for each operating period must include for every staff member the salary, fringe benefits, the terms of employment (full or part-time), and the department to which the salary is charged. Assignment reports from the teaching and research departments in "The Degree Process" are required, showing details of who teaches what classes, and what other assignments (if any) the staff member may have.

Developing the Direct Costs

Since teaching and research are the central functions of a university, the meeting of students and teachers is the unit that best represents the fundamental economic activity in a learning environment. The term "teaching and research" in a university defines the activities of the professional staff, and in reality they are inseparable. A rather arbitrary division is made as a part of the direct cost analysis; but, as will be shown, the expenses are later combined. Whenever the staff meets with students for the purpose of teaching and learning, the term "class" is used to describe this meeting, whether there are 500 students

(as in a large lecture) or one (as in thesis research). In either case the analysis of the class involves a large number of cost factors, especially in "The Degree Process". The analysis described in this chapter will assume that the teachers' salary expense (earnings plus benefits) is the only direct (variable) cost. This assumption ignores the fact that classroom and laboratory supplies are sometimes required and are therefore also a variable expense.

An analysis of the class in "The Degree Process" requires that statistical information about students and staff be available. One source of information is the Registration Report. An example of which in Table 1 lists data for 13 agricultural engineering students in their sophomore year; it illustrates the requirements for student data. This registration report was listed from records which are in sequence by students' field of study and level, and the complete report for one operating period or semester shows similar details for all students in the various fields of study and levels.

By sequencing these same records on subject and course, the total number of students in each field of study and level can be determined for each course. The Course Enrollment Report (Table 2) lists an example of this sequence. The student records provide the necessary data for the direct cost procedure, and the Departmental Report on Staff & Space Assignments (Table 3) illustrates the report that interrelates student and teacher data.

The example of this report shown here for chemistry lists courses 100 and 116. The latter is subdivided into lecture, recitation, and laboratory coded under the heading "Type" as 1, 2, and 4. Chemistry 116 has two classes for the lecture and six each for the recitation and laboratory.

Table 1
1962-63 Registration Report
For Agricultural Engineering Students in one Semester in Their Sophomore Year

Student Number	Student Name	Courses Selected								Crs	Cr. Hr.
230028	Dunn Robert Eugene	AGEN205	E E 205	E SC205	HIST204	MA 261	N S 201	PHYS241		7	20.0
337812	Guske William Charles	AGEN205	E E 205	E SC205	MA 261	MILT230	PHYS241	PSY 120		7	19.0
381398	Hershauer James Cliff	AGEN205	E E 205	E SC205	ENGL185	ENGL238	MA 261	MILT230	PHYS241	8	20.0
399194	Holmgren Dennis Wayne	AGEN205	AGRY105	E SC205	MA 261	PHYS241				5	13.0
400148	Holtman John Benjamin	AGEN205	AGEN335	E E 205	E SC206	MA 262	MILT230	PHYS241		7	19.0
435704	Johnson John William	AGEN205	E E 205	E SC205	HIST204	MA 261	MILT230	PHYS241		7	19.0
723219	Rawlins Paul Robert	AGEN205	ECON210	E E 205	E SC205	MA 261	MILT230	PHYS241		7	19.0
758230	Rouch Keith Edwin	AGEN205	E E 205	E SC205	MA 261	MILT230	PHYS241	SPAN101		7	19.0
785640	Schroeder Reuben W	E E 205	AGEN205	E SC205	MA 261	MILT110	PHYS241			6	16.0
815268	Silverthorn Charlie R	AGEN205	E E 205	E SC205	MA 261	MILT230	PHYS241	PSY 120		7	19.0
844508	Spuller John Dallas	AGEN205	AFT 230	E E 205	E SC205	GER 101	MA 261	PHYS241		7	19.0
847132	Stampe Richard Herbert	SPAN101	AGEN205	E E 205	E SC205	MA 261	MILT230	PHYS241		7	19.0
937639	Watt Donald Lester	AGEN205	E E 205	E SC205	GER 203	MA 262	PHYS241			6	17.0

Total Number of Students = 13 Total Number of Courses = 88 Total Credit Hours = 238.0
Average Student Credit Hours = 18.3

Table 2

Course Enrollment Report

for MATH 161 in First Semester 1962-63

Students Field of Study	Total	Level of the Students					
		Fr.	Soph.	Junior	Senior	Grad I	Grad II
Agriculture	22	19	2	1			
Forestry	3	3					
Aero Engineer	1		1				
Fresh. Engr.	1016	982	34				
Science	273	240	29	4			
Mathematics	1	1					
Indus. Educ.	2	1		1			
Phys. Ed. For Men	1		1				
Home Economics	6	5		1			
Temporary-Under Grad	20	19	1				
Temporary-Grad	1					1	
Grad - BCHM	2				2		
Grad - ENTM	1				1		
Grad - BIOL	2				1	1	
Total Enrollment	1351						

Table 3
DEPARTMENTAL REPORT ON STAFF & SPACE ASSIGNMENTS

1st Semester 1962-63 Session Subject Field Chemistry No. 21
Lafayette Campus Page 1 of 30 Pages

1	2	3	4	5	6	7	8	
Course Number	Type	Section	Time: Days and Hours	No. Wks	Building & Room	Number Students	Contact Instructor Init.	Last Name
100	1	01	M W F 8:30	16	CH 104	88	R.C.	Reiter
		02	M W F 3:30	16	CH 104	81	R.C.	Reiter
116	1	01	M F 12:30	16	CH 200	119	J.H.	Carter
	2	01	T 8:30	16	CH 160	22	T.R.	Fiske
		02	T 8:30	16	CH 221	20	J.D.	Reedy
		03	T 9:30	16	CH 320	17	J.B.	Pausch
		04	T 9:30	16	CH 361	22	T.R.	Fiske
		05	W 12:30	16	CH 420	18	J.D.	Reedy
		06	W 1:30	16	CH 160	20	J.B.	Pausch
	4	01	W 07,08,09	16	FWA 2-25	22	T.R.	Fiske
		02	W 07,08,09	16	FWA 2-23	20	J.D.	Reedy
		03	W 07,08,09	16	FWA 2-15	19	J.B.	Pausch
		04	S 07,08,09	16	FWA 2-25	20	T.R.	Fiske
		05	S 07,08,09	16	FWA 2-23	18	J.D.	Reedy
		06	S 07,08,09	16	FWA w-15	20	J.B.	Pausch

Comments:

The data in Table 3 are keypunched and merged with information about the various classes contained in the Class Teaching Requirements. Table 4 illustrates these requirements for chemistry, showing the number of class hours per week each class meets and estimates of the amount of staff time needed to teach each class. The estimates were determined by conference with the department head and observations of his previous practice in assigning staff. Two sample calculations show how these data are processed to compute the Preliminary FTE (Full Time Equivalent) Staff - the estimate of the amount of time a full-time person will usually spend in teaching this class.[11]

When these requirements have been merged with the assignments from the Assignment Report, a staff service report is produced showing information about each of the classes assigned to the various staff members. Figures 4, 5 and 6 illustrate these reports. The service reports are sent to the department head for inspection, correction, or approval. By making appropriate entries in Part C (the bottom 1/3 of the Report) he indicates his judgment and other assignments if appropriate. Since the department head is the one who makes the assignments, it appears proper that he should be the one who audits these estimates. The alternative is to have the staff member make the estimates on the distribution of his time among the various assignments. This approach has the dis-

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[11] A similar procedure was developed and published by Dean F. J. Kelly, "Adequate Cost Analysis as a Basis for Budget Making" (Journal of Educational Research, 1923, Vol. VII, No. 4, pp. 410f). His concept is based on the assumption that each dean or department head's best policy is to assign staff in such a way that all full-time persons will have equal time-consuming assignments. Any deviation from this policy is a disequilibrium situation and in the long run will be changed at the insistence of the staff member. Part-time staff also will be assigned duties equivalent to their terms of employment.

Table 4
Illustration of Class Teaching Requirements
for Chemistry Classes

Course No.	Type	Class Hours	Full Time Equivalent Staff: Class Hours	Preparation	Per Student
100	1	3.00	.075	.300	
116	1	2.00	.050	.100	
116	2	1.00	.025	.013	.001
116	4	3.00	.075	.025	.006
117	1	2.00	.050	.200	

Sample calculation:

1. Assume a teacher has one class of 21 students in CHEM 116, Type 4 (Lab). Then the estimated time is computed:

Classroom Time	=	.075 FTE Staff
Preparation	=	.025
Per Student: 21 x .006	=	.126
Total for one class		.226 FTE Staff

2. If the teacher had two classes of 21 students each, the estimated time would be:

Classroom Time: 2 x .075	=	.150 FTE Staff
Preparation Time	=	.025
Per Student Time: 2 x 21 x .006	=	.252
Total for two classes		.427 FTE Staff

advantage of introducing personal preferences, which may or may not be the same as the department head who makes the assignments as a part of his administrative responsibilities. Further, these estimates can be used to forecast staff requirements in future operating periods if they are based on a knowledge of the department head's policy with respect to assigning staff time to classes and his class size policy for the proper number of students for each class. Figure 4 presents a report for a professor in electrical engineering who is teaching a three hour graduate level course, 595G, supervising four students in their thesis research, course 699, directing a research project, and planning a departmental seminar. The last two assignments have been written in by the department head.

Figure 5 is a service report for an instructor in modern languages who devotes 100 per cent of his time to teaching classes; Figure 6 is a report for a half-time graduate assistant in chemistry who teaches recitation and laboratory classes in general chemistry.

The payroll records provide the earnings data for each member of the staff plus an indication of their participation in the various fringe benefit programs. From the point of view of the university, the salary expense for each member is the sum of his earnings plus whatever benefits are paid for him; that is payments to the Federal Insurance Contributions Act, retirement, and group insurance programs. Also, a statement as to the terms of employment between the staff member and the university is required as an FTE Staff percentage, usually 100 per cent, 75 per cent, 50 per cent, 25 per cent, for this operating period.

The non-teaching assignments listed in Parts B and C on the service reports are keypunched and consolidated with the staff payroll data and

To Heads of Departments:
The completion of this Report for the staff member listed will provide data for the University's request for funds from the State. *Therefore please review the instructions carefully before completing it.*

A **The teaching assignments for the current semester or session are listed below as submitted by your department on the Master Class Organization Report. If there have been any changes in these assignments, indicate the current status.**

CAMPUS ASSN	COURSE DATA			CLASS DATA					
	SUBJECT FIELD	NUMBER & SUFFIX	TYPE CLASS	HOURS	STUDENTS	NO OF CLASSES	WEEKS		PRELIMINARY F T E STAFF
	EE	595G	1	3.00	31	1.00	16		.330
	EE	699	9		4	1.00	16		.250
							TOTAL PREL. FTE STAFF		.580

B **Since the Master Class Organization Report provides information on contact teaching assignments only, it is necessary to supplement this information if part A does not represent all the assignments to instruction. List in section 1 below any additional assignments to regular course instruction, specifying each course and type of class served and the nature of the service, such as supervising or coordinating instructors teaching a multiple-section course, or such as teaching assistance -- grading papers, preparing laboratory materials, etc. In section 2 indicate counselling assignments, and in section 3 indicate thesis research activities.**

	CAMPUS	SUBJECT FIELD	COURSE NO	TYPE	DESCRIBE ASSIGNMENTS & ENTER APPROPRIATE % FOR EACH ——— ▶	ESTIMATED % F.T.E. STAFF
1						
2	COMPARABLE FOR _____ SCHOOL (CURRICULUM) INDICATE STUDENT LEVEL _____ IF PERTINENT					ENTER % ▶
3	FOR STAFF IN ADVANCED DEGREE ACTIVITIES: If this individual serves on 698 and 699 committees, or assists in thesis research that is not represented by assignments in A above, such as thesis reading, candidate examinations, research assistance, etc., enter % _____					

C **If this staff member is employed full time by the University this session including all assignments, write 100 here; if half-time, write 50; etc.** ..... 100 %

THE ABOVE PERCENTAGE IS SUBDIVIDED APPROXIMATELY AS FOLLOWS:

INSTRUCTION, For all of A and B above ..... 60 %

RESEARCH, Organized (Project Number 3426-50-780) ..... 25 %

RESEARCH, Departmental. Describe _____ ..... %

PUBLIC SERVICE. Describe _____ ..... %

ADMINISTRATION in this (or _____ **) department** ..... 15 %

Check Duties:

- ___ General Dept Adm
- ___ Bldg Supervision
- ___ Schedule Deputy
- ___ Space Deputy
- ___ Maint - Equip & Supplies
- ___ Other _____
- ✓ Advance Planning & Development
- ___ Instructional Programs
- ___ Research Programs
- ___ Bldgs & Related Equip

Department Seminar Program

ASSIGNMENTS OTHER THAN ABOVE. Describe _____ ..... %

Figure 4
Service Report for an Associate Professor in the Department of Electrical Engineering

To Heads of Departments:
The completion of this Report for the staff member listed will provide data for the University's request for funds from the State. *Therefore please review the instructions carefully before completing it.*

A The teaching assignments for the current semester or session are listed below as submitted by your department on the Master Class Organization Report. If there have been any changes in these assignments, indicate the current status.

CAMPUS ABBR.	COURSE DATA			CLASS DATA					
	SUBJECT FIELD	NUMBER & SUFFIX	TYPE CLASS	HOURS	STUDENTS	NO. OF CLASSES	WEEKS		PRELIMINARY FTE STAFF
	SPAN	102	1	6.00	43	2.00	16		.498
	SPAN	102	4	1.00	48	1.00	16		.073
	SPAN	264	1	2.00	10	1.00	16		.130
	SPAN	264	4	2.00	10	1.00	16		.100
	SPAN	360	1	3.00	15	1.00	16		.255
						TOTAL PREL. FTE STAFF			1.056

B Since the Master Class Organization Report provides information on contact teaching assignments only, it is necessary to supplement this information if part A does not represent all the assignments to Instruction. List in section 1 below any additional assignments to regular course instruction, specifying each course and type of class served and the nature of the service, such as supervising or coordinating instructors teaching a multiple-section course, or such as teaching assistance -- grading papers, preparing laboratory materials, etc. In section 2 indicate counselling assignments, and in section 3 indicate thesis research activities.

	CAMPUS	SUBJECT FIELD	COURSE NO.	TYPE	DESCRIBE ASSIGNMENTS & ENTER APPROPRIATE % FOR EACH ——→	ESTIMATED % F.T.E. STAFF
1						
2	COUNSELLOR FOR _____ SCHOOL (CURRICULUM) INDICATE STUDENT LEVEL _____ IF PERTINENT				ENTER % →	
3	FOR STAFF IN ADVANCED DEGREE ACTIVITIES: If this individual serves on 698 and 699 committees, or assists in thesis research that is not represented by assignments in A above, such as theses reading, candidate examinations, research assistance, etc, enter % _____ →					

C If this staff member is employed full time by the University this session including all assignments, write 100 here; if half-time, write 50; etc. . . . . 100 %

THE ABOVE PERCENTAGE IS SUBDIVIDED APPROXIMATELY AS FOLLOWS:

INSTRUCTION, For all of A and B above . . . . . 100 %

RESEARCH, Organized (Project Number _____) . . . . . %

RESEARCH, Departmental. Describe _____ . . . . . %

PUBLIC SERVICE. Describe _____ . . . . . %

ADMINISTRATION in this (or _____) department. . . . . %

Check Duties:

___ General Dept. Adm.
___ Bldg. Supervision
___ Schedule Deputy
___ Space Deputy
___ Mgmt. - Equip. & Supplies
___ Other _____
___ Advance Planning & Development.
___ Instructional Programs
___ Research Programs
___ Bldgs. & Related Equip.

ASSIGNMENTS OTHER THAN ABOVE. Describe _____ . . . . . %

Figure 5
Service Report for an Instructor in the Department of Modern Languages

To Heads of Departments:
The completion of this Report for the staff member listed will provide data for the University's request for funds from the State. *Therefore please review the instructions carefully before completing it.*

A The teaching assignments for the current semester or session are listed below as submitted by your department on the Master Class Organization Report. If there have been any changes in these assignments, indicate the current status.

CAMPUS ABBR.	COURSE DATA			CLASS DATA					
	SUBJECT FIELD	NUMBER & SUFFIX	TYPE CLASS.	HOURS	STUDENTS	NO. OF CLASSES	WEEKS		PRELIMINARY F.T.E. STAFF
	CHM	116	2	2.00	44	2.00	16		.063
	CHM	116	4	6.00	42	2.00	16		.427
								TOTAL PREL. FTE STAFF	.490

B Since the Master Class Organization Report provides information on contact teaching assignments only, it is necessary to supplement this information if part A does not represent all the assignments to Instruction. List in section 1 below any additional assignments to regular course instruction, specifying each course and type of class served and the nature of the service, such as supervising or coordinating instructors teaching a multiple-section course, or such as teaching assistance -- grading papers, preparing laboratory materials, etc. In section 2 indicate counselling assignments, and in section 3 indicate thesis research activities.

	CAMPUS	SUBJECT FIELD	COURSE NO.	TYPE	DESCRIBE ASSIGNMENTS & ENTER APPROPRIATE % FOR EACH ——→	ESTIMATED % F.T.E. STAFF
1						
2	COUNSELLOR FOR _____ SCHOOL (CURRICULUM) INDICATE STUDENT LEVEL _____ IF PERTINENT				ENTER %→	
3	FOR STAFF IN ADVANCED-DEGREE ACTIVITIES: If this individual serves on 698 and 699 committees, or assists in thesis research that is not represented by assignments in A above, such as theses reading, candidate examinations, research assistance, etc, enter %_____					

C If this staff member is employed full time by the University this session including all assignments, write 100 here; if half-time, write 50; etc. . . . . 50 %

THE ABOVE PERCENTAGE IS SUBDIVIDED APPROXIMATELY AS FOLLOWS:

INSTRUCTION, For all of A and B above . . . . . 40 %

RESEARCH, Organized (Project Number _____) . . . . . %

RESEARCH, Departmental. Describe _____ . . . . . %

PUBLIC SERVICE. Describe _____ . . . . . %

ADMINISTRATION in this (or _____) department. . . . . %

Check Duties:

___ General Dept. Adm. ___ Bldg. Supervision ___ Schedule Deputy ___ Space Deputy ___ Mgmt. Equip & Supplies ___ Other _____ ___ Advance Planning & Development ___ Instructional Programs ___ Research Programs ___ Bldgs. & Related Equip.

ASSIGNMENTS OTHER THAN ABOVE. Describe _____ . . . . . %

Figure 6
Service Report for a Graduate Assistant in the Department of Chemistry

the teaching assignments. Table 5 illustrates the computation of the final values for each of the various assignments, both in staff time and salary expense. The left hand column of Table 5 indicates the source of the data. The example is for a staff member charged to education by the Payroll Department, who is employed full time and whose earnings plus benefits are $5,750 for the semester. This amount is distributed to each of the teaching and non-teaching assignments, such that the sum of the assigned FTE Staff and assigned salary expense are equal to the employed FTE Staff and salary expense. (Note that the non-teaching assignments are entered as assigned FTE Staff.) The mathematics 100 course has been charged with $1,322, education 300 with $1,552, the Conference & Correspondence Department with $1,438, research in education with $575, and adminstration in education with $863.

By sequencing those assignments that have both assigned FTE Staff and salary expense by course and type of class or other assignment, the total course expense and expenses for the other activities within each department are computed.

Table 6 is a partial listing of courses offered by the Chemistry Department during the first semester 1962-63 and their total cost. This table illustrates the determination of the direct cost, that is the salary expenses. Each course (identified at the right) has an entry showing the number of students, student class hours, the average number of students per class, the amount of professional and/or graduate assistant FTE Staff time and salary expense involved in teaching this course, the average salary level of the staff members teaching the course (on an academic-year basis) and the total salary expense. By considering each of these elements separately it is possible to appreciate why the direct

Table 5

Computing the Salary Expense for Staff Assignments

An example for one full-time person in the Department of Education, paid $1,000 per month or $5,000 for a semester.

Full-Time Equivalent Staff

Data Source	Department	Assignment	Employ	Prelim	Assigned	Earnings	Benefits	Sal Exp	Assign. Expense
Payroll	ED		1.000			5,000	750	5,750	
Teaching	MATH	100, Type 1		.269	.230				1,322
Teaching	ED	300, Type 1		.316	.270				1,552
Non-Teach	Conf. & Corr.				.250				1,438
Non-Teach	ED	Research			.100				575
Non-Teach	ED	Admin.			.150				863
Total			1.000	.585	1.000			5,750	5,750

Table 6

Partial Listing of Chemistry Courses

for First Semester 1962-63

Students Enrl	Cl-Hrs	Average Student/ Class	FTE/ Cl	Professional Salary	FTE	Grad Assistant Salary	FTE	Average Salary	Total Salary	Indirect Expense	Total Expense	Cost/ Student	Course & Type
231	693	115	.61	$1,411	.46	$1,725	.75	$ 5,178	$3,136	$ 2,957	$ 6,093	26	100, 1
306	612	153	.24	2,456	.48			10,297	2,456	1,777	4,233	13	116, 1
306	306	20	.05	761	.21	1,461	.58	5,624	2,222	1,665	3,887	12	116, 2
306	918	22	.26	1,455	.31	8,451	3.35	5,408	9,906	11,787	21,693	70	116, 4
124	PhD Thesis Research			45,687	6.45			14,163	45,687	83,317	129,054	1,040	699, 9

course expense is what it is. In other words, the cost varies with the salary level of the teacher, the number of hours the classes meet each week, and the amount of staff time needed to teach the classes. If the per-student cost is to be analyzed, then the number of students in the course is another variable to be considered. The question of how the indirect expenses for each course are determined will be illustrated below under the topic, "Developing the Indirect Costs".

The direct expenses for 'The Conference & Correspondence Process" and "The Field Service Process" are determined along with 'The Degree Process". If an individual staff member has had assignments in 'The Degree Process", his salary is credited to the department to which it was charged. It is then redistributed to the departments for which his services were performed. This procedure is illustrated in Table 5 which shows the transfer of salary expenses for a person charged to the Education Department but assigned to teach a class offered by the Mathematics Department. Similarly, assignments to "The Conference & Correspondence" or "The Field Service Process" receive salary charges.

The re-distribution procedure establishes the direct expense for the various processes, assuming that the correct assignment was made for the professional staff charged to 'The Conference & Correspondence" and 'The Field Service Process" department and not analyzed in the service report apparatus.

Another part of the direct cost procedure in "The Degree Process" involves computing the student fee income. For each student it is necessary to generate one record with appropriate statistical data and match this record with one the Bursar uses to record fees paid. From this match it is possible to determine by the fields of study and level how

much the students contribute to the university's general fund income, excluding dedicated fees for residence halls, health service, football tickets, and the like. Included are such things as non-resident fees, general service fees, and fees waived for persons who receive scholarships. In the fee study, the student fee income for each field of study and student level is averaged, and the direct cost process is completed.

Developing the Indirect Costs

Initially several miscellaneous distributions (outside the main system of allocations) need to be made. First, the overhead recovery for contract research is transferred from a single income account to the departments that earned the income. The transfer is made on the basis of the amount each department contributed to the income. Then the total expense in the general funds for equipment is computed, and each department's equipment expense is revised. The assumption is made that the total expense for equipment is an approximation of the depreciation expense, and this amount is redistributed to each department based on the ratio of the current value of the equipment each department has in its inventory to the total value of the equipment in the university. The purchase price for equipment should not be a part of the expenses of a department in the year of acquistion, but the depreciation should. Universities in general do not have the necessary depreciation schedules, so the former method is employed.

Finally, departmental income in "The Degree Process" departments is netted against expenses to complete these miscellaneous distributions.

As a part of the payroll procedure, the staff benefits are accumulated by department from the individual records for each staff member charged to the department.

Figure 7 presents a schematic diagram of the indirect expense allocations, which start when the staff benefits have been charged to all departments and have been credited to the general expense account. This step is indicated on the flow diagram by the dotted lines originating from the circle enclosing the words "Fringe Benefits".

Next the expenses of physical plant are allocated to the departments, and these expenses include not only those incurred by that department but also the physical plant's share of the staff benefits charged previously. The square footage assigned to each department is the statistical basis for making this allocation. In a general way this probably represents a reasonable basis for determining a department's participation in this expense. Admittedly this is an over-simplification, and additional study needs to be made for a better distribution of this large and growing expense.

Next the General University Administration and Expense is allocated to all departments (except physical plant and the deans' administration).[12] The statistical basis employed to allocate this pool of expense is the gross expense in each department that is to be charged. The doctoral thesis of F. R. Ford[13] examined the growth of these expenses over a 40 year period at Purdue University. Dr. Ford discovered a linear relationship between the expense for teaching and research and this category, General University Administration & Expense. His finding is the basis for this allocation. Again, the expenses allocated include

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[12] The "deans' administration" refers to a separate expense account for a dean and his staff in those schools or colleges which supervise several departments. If a dean has only one or two departments for which he is responsible, usually no separate account is maintained.

[13] F. R. Ford, The Growth of Supporting Operations within a University Organization: A Historical Study, unpublished, Purdue University, Lafayette, Indiana, 1962.

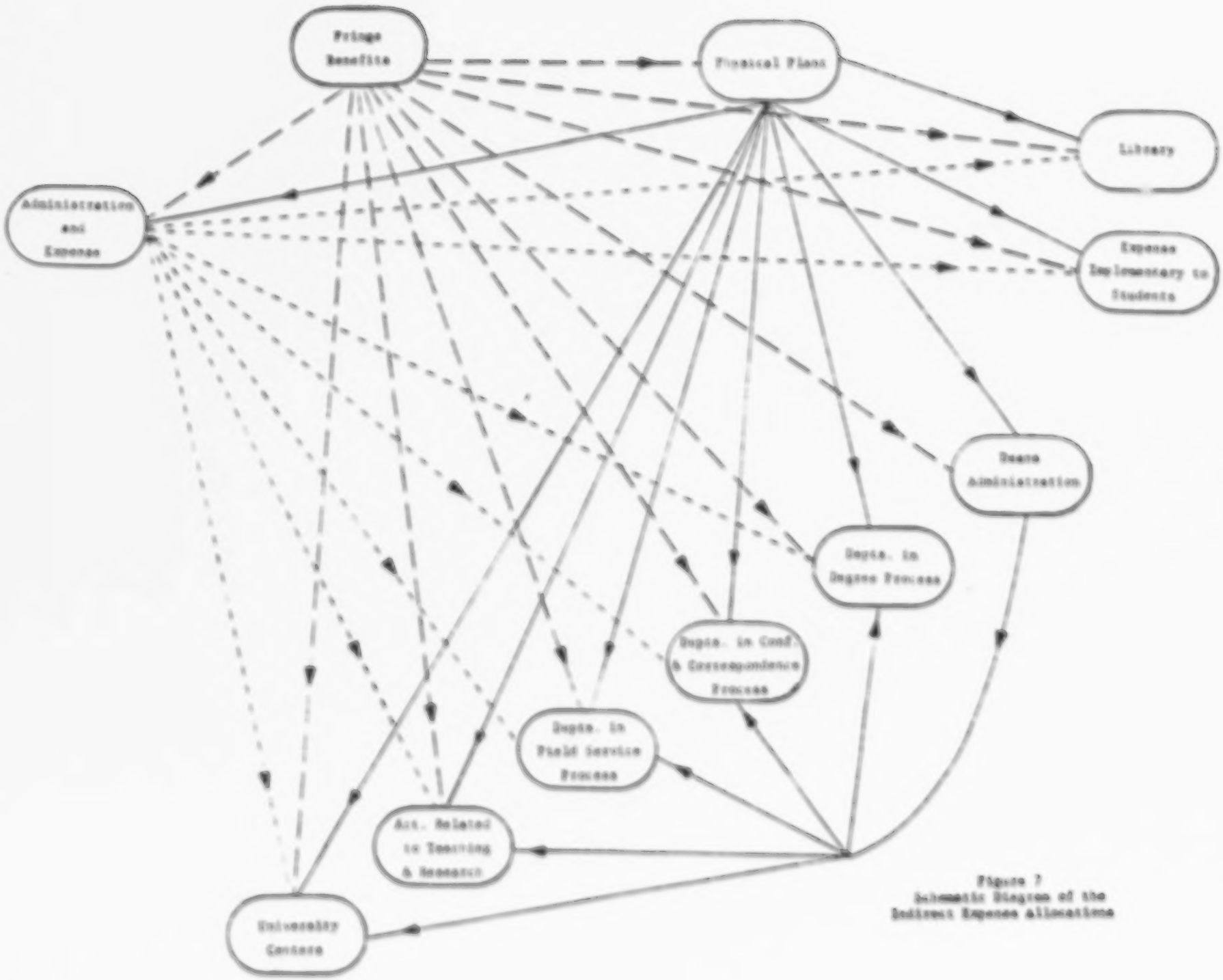

Figure 7
Schematic Diagram of the Indirect Expense Allocations

those incurred by the departments in this group (the offices of the President, the Vice President & Treasurer, the Business Manager, Alumni Relations, University News Service,.....) plus the expenses previously allocated to these departments.

The expenses of the library, including all previous allocations, are divided among the users. Information for this division came from a comprehensive study[14] of the expense and users, and resulted in a distribution of 16 per cent of the expense assignable to undergraduate students, 46 per cent to graduate students, and 38 per cent to the faculty in direct proportion to the use of the library by these groups. The faculty portion (38 per cent) is distributed on an FTE Staff statistical basis to the teaching and research departments in "The Degree Process" and to certain departments in "The Field Service Process" that use the library. The remaining 62 per cent will be allocated as an implementary expense to the several students' fields of study and levels on a student-population statistical basis (see Table 8).

The General University Expenses Implementary to Students are separated into those that are provided for graduate and those for undergraduate students and then allocated to student fields of study and level on a student-population basis. This pool of expense includes expenses for the offices of the Registrar, the Dean of Men, the Dean of Women, the Graduate School, the Intramural Athletics, and others whose function is to serve primarily students rather than staff members.

The expenses that are implementary to students are not allocated to

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[14] Gerald L. Quatman, The Cost of Providing Library Services to Groups in the Purdue University Community - 1961, Purdue University Libraries, Lafayette, Indiana, 1962.

the various teaching and research departments in "The Degree Process", but to the student fields of study. The results of this allocation will be shown later.

After the expenses of the dean's administration have been allocated to the departments under his authority, all allocations have been made; and the overhead of the university has been distributed to all departments in the three processes.

To give an example of the final product from this allocation process, Table 7 has been prepared to illustrate an income and expense statement for the Department of Aeronautics and Engineering Sciences. Note that the department's expenses are separated into Teaching and Research, and both have direct and indirect expenses. The Research expenses, listed on the right in Table 7, are discussed first.

The grants for contract research, listed under "Paid from Special Grants", are included in this study for two reasons: they must be considered as an integral part of the research activities of this or any other department, and the gross expense of a department is the statistical basis for allocating the "General University Administration and Expense". If contract research were excluded, the allocation to research in the several departments would be understated.

The general funds of the university support salaries and the indirect expenses which are shown under "Paid from General Funds". The salary expense data are taken from the service report analysis as is the total amount of departmental administration. The latter has been divided between teaching and research on an FTE Staff statistical basis.

At the beginning of this section, it was explained that the income received from contract research to cover the university overhead was

Table 1

[illegible]

Teaching		
Direct Expenses		
Professional Staff Salary Expense		[illegible]
Grad Asst. or Part Time Salary Exp		$2,505
Total of Direct Expenses		[illegible]
Indirect Expenses - Division or Dept		
Clerical Staff Salary Expense	$8,568	
Supplies & Expense	$5,625	
Total FE		$1,193
Service Staff Salary Expense	$1,568	
Supplies & Expense	$5,625	
Total FE		[illegible]
Indirect Expenses - University Wide		
Administration		
[illegible]		
[illegible]		
[illegible]		
[illegible]		
[illegible]		
[illegible]		
[illegible]		
[illegible]		
[illegible]		
[illegible]		
[illegible]		
[illegible]		
[illegible]		
[illegible]		
[illegible]		
[illegible]		

Research	
[illegible]	
[illegible]	
[illegible]	

distributed to the departments that earned this income. The item "Income from Research Overhead" in Table 7 shows Aeronautics & Engineering Science's portion of this income, $50,614. It is an off-set to the total "Indirect Expense Allocation" of $80,677.

The item transfers of professional salaries to cover teaching assignments represents staff salaries paid from special grants but used to supervise graduate students working on their thesis research. These students select a course called "M. S. (or Ph.D) Thesis Research". In some cases this teaching expense is paid from special grants.

"Contributed Salaries" is the off-setting amount introduced for staff members who supervise thesis research but who are not on the payroll. This situation can occur (1) because the persons are not university employees but are a part of the environment for learning (e.g. United States Department of Agriculture research personnel who work at a university) or (2) in the summer session when academic-year appointees supervise thesis research without compensation.

The "Total Expense" and "Net Expense" are determined and the latter transferred to "Teaching". This transfer assumes that teaching and research in a university are essentially one, and they are both related to students.

The expenses for "Teaching" shown on the left for this department are set forth as direct and indirect, with the analysis of the latter having been covered earlier in "Developing the Direct Costs". All indirect expenses are distributed to courses. The direct expenses incurred by the department are separated into those that are implementary to staff and those implementary to students. The reason for the separation is related to the distribution of these expenses to

the courses offered by the department; one is distributed on an FTE Staff statistical basis and the other on student class hours. The equipment expense (or estimated depreciation expense) which was allocated to this department has been added to the Supplies and Expense account, and it will be distributed on a student-class-hour statistical basis.

The expenses of "Administration" of the department have been discussed above. This cost is distributed to courses on an FTE Staff statistical basis on the assumption that 'administration' means directing people. The "Research" expense is distributed to courses with 80 per cent assigned to thesis research courses and 20 per cent to all other courses on an FTE Staff statistical basis. The reasoning that underlies this distribution of 80 per cent to thesis research is the fact that this expense is implementary to students who are learning to do research. It seems appropriate, therefore, that these courses should bear a large part of this expense. The 20 per cent distributed to all courses on an FTE Staff statistical basis assumes that research, in general, stimulates and motivates all the staff, and some of this expense should be borne by all courses. Admittedly the 80 - 20 division is arbitrary, but not without logic.

The "Physical Plant" expenses were allocated to departments on a square-foot-of-assigned-space statistical basis. Because the largest part of departmental space is classrooms and laboratories and these are implementary to students, the expense is allocated to courses on a student-class-hour statistical basis. Laboratory classes are weighted four times that of non-laboratory classes. This particular weighting scheme is used because of the relative size of the student-stations between the two types of space.

The "Library" expenses allocated to this department are distributed to courses on an FTE Staff statistical basis, just as the expenses were brought to the department in the first place.

The expenses for "Computer Activities" are the only "Activities Related to Teaching & Research" in this department, and these costs were incurred when several staff members, both professional staff and graduate students, were assigned to work on a computer project. A conference with the head of the department revealed that about 40 per cent of this expense should be distributed to the two courses that teach computer programming and 60 per cent to thesis research courses which used the computer for processing theses data. When the department expenses have been distributed to all courses on the appropriate basis, the courses bear their share of the total indirect expenses.

It is now possible to complete the examination of Table 6 and understand how each course is charged with its pro-rata share of the indirect expenses which were either incurred by the department or allocated to it. Throughout the discussion of both direct and indirect expenses, the judgment factors that are involved in each decision were presented. That these expenses are estimates is obvious, and identical problems are faced whenever any production unit has joint products.

The final illustration of the analysis of "The Degree Process" is shown in Table 8. It presents income and expense data for 193 students in one semester of their sophomore year in the electrical engineering field of study showing that these students have selected a wide array of courses. The total cost of these courses is $82,990 or $430 per student on the average. To this cost is added the expenses implementary to students: general university expenses and the library expenses that

Table 8
1962-63 Income & Expense Statement
for 193 Students in Electrical Engineering Field of Study
in one semester of their Sophomore year

Course Identification		Course Enrollment	Course Expense per Student	Total Process Expense
A&D 103	Non Lab I	5	$ 10	$ 50
	Lab	5	82	410
A&D 113	Non Lab I	3	18	54
	Lab	3	78	234
A&D 402	Ind	2	129	258
BAND 210	Lab	8	94	752
ECON 210	Non Lab I	19	12	228
	Non Lab II	19	22	418
EE 203	Non Lab I	181	39	7,059
	Non Lab II	181	52	9,412
	Lab	181	62	11,222
EE 204	Non Lab I	5	8	40
	Non Lab II	5	103	515
	Lab	5	97	485
ESC 301	Non Lab I	4	66	264
ENGL 185	Lab	5	33	165
MATH 261	Non Lab I	136	9	1,224
	Non Lab II	136	40	5,440
MATH 262	Non Lab I	45	12	540
	Non Lab II	45	35	1,575
PHYS 261	Non Lab I	145	24	3,480
	Non Lab II	145	37	5,365
SPE 314	Non Lab I	2	90	180

		Average Expense or Income, per Student
Expenses for 193 students in Electrical Engineering student's field of study in Sophomore year:		
Course Expenses	$ 82,990	$430
Other Expenses:		
Gen. Univ. Exp. Implementary to Students	11,330	59
Library (Implementary to Students)	2,172	11
Total Expenses	96,492	500
Less Income: Student Fees	39,951	207
Net Cost to the State of Indiana	$ 56,541	$293

are assignable to these 193 students. The total expense for these students is $96,492 of which $39,951 were paid by the students themselves. The remainder, at Purdue University, is borne by the State of Indiana. In other insitutions it might be paid by endowment income, or it might be borne by the institution itself if the current operations were running a deficit. No doubt there are universities that have a combination of all these sources of funds, and the division among them at any one institution will depend on judgmental factors as well as on how the donor intended the income to be used.

In order to reduce the amount of details, the methodology of analyzing "The Conference & Correspondence Process" and "The Field Service Process" are omitted, with the understanding that similar statements of income and expense can be determined for them. Neither of these processes is assigned participation in the "General University Expenses Implementary to Students", however, but otherwise the same categories of income and expense are involved.

The analysis presented in Table 8, "1962-63 Income & Expense Statement", summarized the financial elements involved in providing the environment for learning for 193 sophomore students in the electrical engineering field of study for one semester at Purdue University. In order to give some indication of how one semester for one portion of "The Degree Process" is related to the other processes, Table 9 has been prepared. It shows a combined cost for "The Degree Process" for the three operating periods (two semesters and a summer session) and averages the cost for freshmen, sophomore, junior, senior, and graduate students by combining the various students' fields of study and the two levels of graduate students. "The Conference & Correspond-

Table 9
Purdue University 1962-63 Cost Study

	Ave. Regn.*	Total Course Expense	Exp. Impl. to Students: Gen. Univ.	Exp. Impl. to Students: Library	Total Expenses	Less Income Student Fees	Net Cost to State	Per Student Cost to State
I. The Degree Process								
A. Main Campus								
1. Freshmen Students	3,875	2,871,808	621,042	113,151	3,606,001	1,016,003	2,589,998	668.
2. Sophomore Students	3,891	3,162,348	539,194	104,587	3,806,129	989,774	2,816,355	724
3. Junior Students	3,319	3,605,290	459,930	89,212	4,154,432	844,271	3,310,161	997
4. Senior Students	2,778	3,478,224	409,938	74,671	3,962,833	706,654	3,256,179	1,172
5. Graduate Students	4,003	6,874,475	464,912	740,040	8,079,427	537,437	7,541,990	1,884
6. Vet. Medicine, Prof. Students	201	729,107	13,201	29,779	772,087	52,929	719,158	3,578
B. Extension Centers		2,141,562	142,946	175,685	2,460,194	1,129,568	1,330,625	
		22,862,814	2,651,163	1,327,125	26,841,103	5,276,636	21,564,466	
II. The Conf. & Correspondence Process								
A. Adult Education					716,504	700,131	16,364	
B. Miscellaneous					257,378		257,378	
III. The Field Service Process						Misc.		
A. Agricultural Experiment Station					3,005,514	161,162	2,844,352	
B. Cooperative Extension Service					1,073,521	22,629	1,050,892	
C. Engineering Experiment Station					152,965	24,984	127,981	
Net Cost to the State of Indiana (per Acts of Legislature, 1961-63)							$25,861,433	

*Average Registration =
First Semester Registration x .50
+ Second Semester Registration x .50
+ Summer Session Registration x .25

ence Process" and 'The Field Service Process" are shown also, with the sum of the net expenses for all processes being the state appropriation for 1962-63.

Table 9 shows that sophomore students cost the State of Indiana $724 per student on the average in 1962-63. Since a single semester is about 40 per cent of a fiscal year in terms of time and expense, the average cost would be $316 per student for one semester ($790 x 40 per cent). This cost is comparable with the cost of $293 per student listed in Table 8, and shows that electrical engineers in their sophomore year cost less than the university average.

IV. THE SIGNIFICANCE OF THE COST STUDY PROCEDURE

The procedure described in Chapter III completes what was referred to as a Manual of Instruction in the "Introduction". It has been included in this work because no other publication on cost analysis for a university describes this type of procedure. Without this methodology or one similar, it is not possible to employ analytical tools, because there is no possibility of analyzing data that are not in a format that permits the analysis. The "standard" cost study that is usually employed by universities considers student credit hours or full-time-equivalent students as the basis for computing costs, and these studies have been discredited since their inception.[15] Why they continue to be used is difficult to understand.

Analysis of the "Building Blocks"

Chapter II described this procedure as a construction of costs with physical units as building blocks, meaning this micro-analysis starts with the smallest economic units in the environment for learning and combines them to determine the total costs. This analysis of the building blocks, the classes, is the most important consideration in any forecast of financial needs of "The Degree Process". The cost function showed that changes in cost are proportional to the number of classes. This analysis of the building blocks investigates the factors that determine

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[15] Financial Reports for Colleges and Universities, The University of Chicago Press, Chicago, 1935, pp. 177 ff.

the number of classes and the cost of the input factors (both variable and fixed) that produce the class.

The factor that determines the number of classes for any course is the class size policy that the department considers appropriate. If the policy is changed by increasing the number of students per class, the number of classes will be reduced. If the number of students per class is decreased, the number of classes will increase.

The cost of classes is influenced primarily by the salary level of the teacher and the amount of the teacher's time that is assigned to the class. One way to change the cost of the class, therefore, is to change the salary level of the teacher by assigning either higher or lower paid staff members to it. Still another way to influence the cost of the class is to allow more or less time for teaching the class. Since the salary expense per class is determined from the product of the staff member's salary times the staff member's time (expressed as a percentage), increases or decreases in either or both factors act in the same direction with the costs following increases or decreases.

Should the class have other variable expenses, the cost can also be changed by either substituting less expensive items for the more costly, using fewer of the items, or discontinuing the use of the items.

It was pointed out in Chapter II that a university can grow indefinitely from a study of the economics-of-operation, though there may be dis-economies of size in the management costs. The question of whether or not these dis-economies exist can only be studied meaningfully in relation to the classes. The "fixed costs" (which may in reality be variable costs) may be growing in any institution quite rapidly, but these costs must be related to the classes in the environment for

learning if any objective answers are sought to questions about the costs being "too high" or "growing too fast". These questions can be observed either historically by comparing the fixed costs per class through time or with a simulation model. The latter demonstration will require the assumption that was followed to allocate the expenses of the category "General University Administration & Expense" to be revised. This assumption was derived from the observation that these expenses historically were proportionally related to total expenses for teaching and research, which treats these expenses as variable costs. In fact they are not variable but fixed costs within any one planning period. An answer to the question of what influences their changing must be discovered. Probably another simulation model can be constructed to make this analysis, considering both the factors that are fixed in an absolute sense (every university will need a chief executive officer, a financial officer, a registrar, and an administrator who supervises the activities of the teaching and research staff) and those factors that are variable to the level of the operations of the various administrative units.

Development of the Simulation Model from the Cost Computations

The assignment of costs to classes detailed in Chapter III describes a careful analysis for portraying the economic factors in operation in an environment for learning. This technique is important not only to give realistic estimates of the present costs but also to provide data for the simulation model.

This second use of the data involves developing a "Total Class Requirement" for each class. This concept is similar to a bill-of-materials approach that a factory uses to simulate production. Table 6,

"A Partial List of Chemistry Courses with Expenses" illustrates the fact that data on staff time needed to teach each class and the salary level of the teacher have been determined, with the remaining problem one of segregating the "Indirect Expense" into variable and fixed costs. Chapter III also explained the allocation and distribution process; and Table 7, "1962-63 Income & Expense Statement for the Department of Aeronautics & Engineering Science", illustrates the elements that must be separated.

The analysis of the "Indirect Expenses - Incurred by Department" (shown in Table 7) which are implementary to students must be assigned to the classes that generate these costs. The basis for this allocation presupposes a study of each department to secure the information class by class. The results from this survey will be a factor for each class that gives the variable cost per student, analogous to the per-student factors in Table 4, "The Class Teaching Requirements".

The category in Table 7 labeled, "Indirect Expenses - Allocated to Department" are largely the fixed costs, with the exception of the net cost of research which came from the analysis of both special-grant and general fund research activities. Some simplifying assumption can be made to express these research costs, possibly as a variable cost per student for students enrolled in thesis research.

These two elements of the variable cost, direct salary expense and per-student expense, generalize the 'Total Class Requirement" idea. The details of the per-student factors for any one class can include laboratory or classroom supplies, depreciation for specialized laboratory equipment, the net cost of thesis research, and costs of "Activities Related to Teaching & Research" which are needed for specific classes.

Average Variable Cost = $\frac{d_2}{c_2} = \frac{d_1}{c_1}$ = AVC

Marginal Cost = $\frac{\Delta d}{\Delta c}$ = MC

If variable cost curve is a straight line, $\frac{\Delta d}{\Delta c} = \frac{d_2}{c_2}$ based on the geometry of similar triangles. Thus AVC = MC

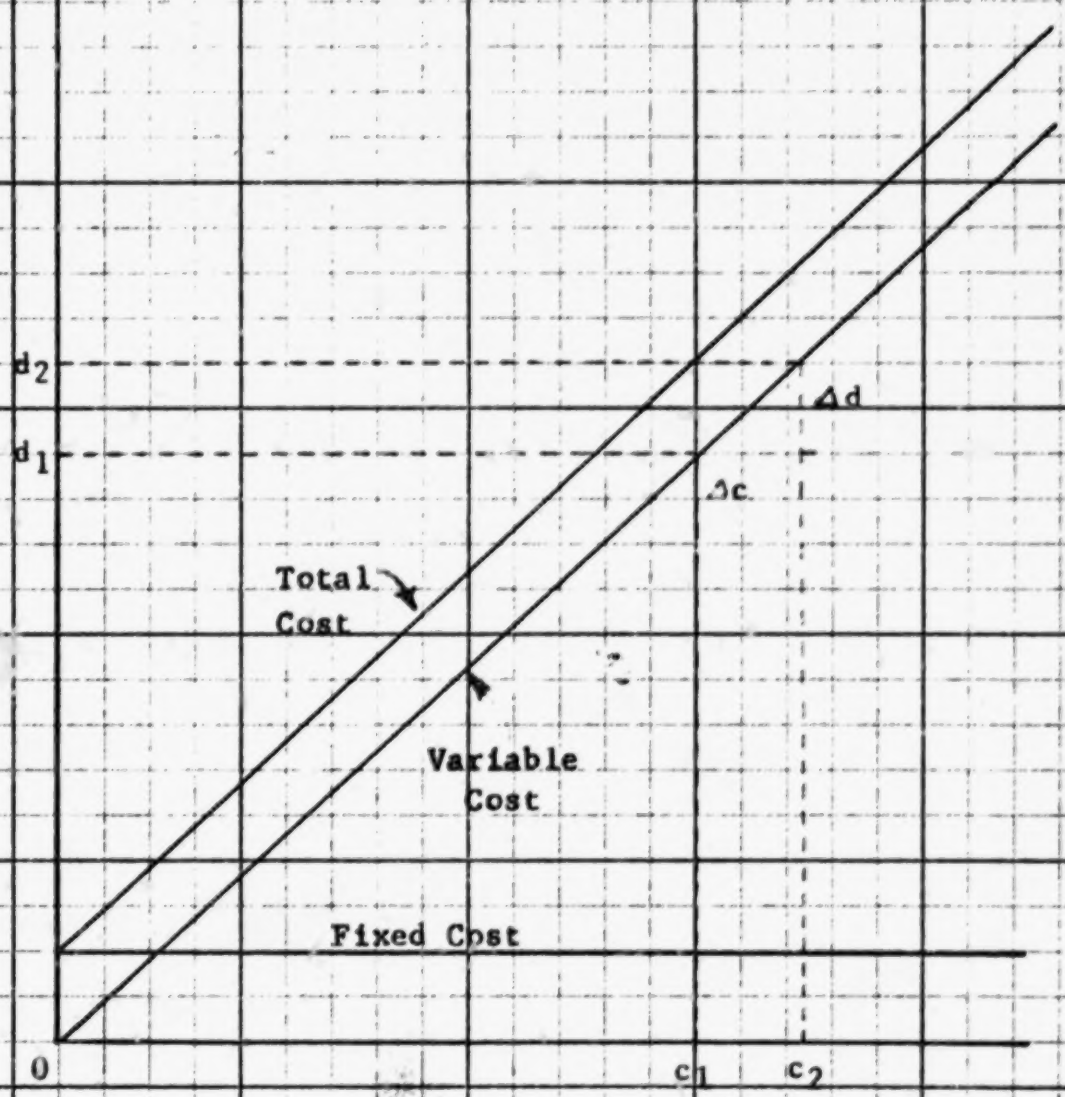

Figure 8
Relationship between Marginal & Variable Cost

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When these per-student factors become known, they not only can be used in the simulation model but also in the computation of costs by using the factors as a statistical basis on which the variable expenses of the department can be distributed to the various classes.

Inherent in this simulation model is the fact that the average variable cost of each class is equal to the marginal costs. Figure 8 illustrates the geometrical relationships that must exist if marginal cost and average variable cost are equal, which demonstrates that there is a linear relationship between cost and output. This relationship means that the marginal class does not induce a greater-than- or less-than- proportional increase in output. From this result, it is apparent that the variable cost curve computed in the simulation model will be a straight line which, if extended, would go through the origin. The marginal and average variable cost curves will be a horizontal straight line without the upturn beyond c' shown in Figures 1 and 2.

Horizontal marginal and average cost curves are a result to be expected because of the parameters in the simulation model. There are no constraints within the model on the number of classes that can be offered in the planning period. It is therefore not possible to recognize the size of the plant or to forecast when the level of operations goes beyond c' where variable costs begin to rise. Perhaps it will be possible to determine this constraint with a more sophisticated model, interrelating the simulation model with the new scheduling techniques referred to in the next section. The model described in this section does not now have this feature.

The interdependency of the simulation model and the cost computations denotes that future costs will be based on current costs,

modified by anticipated salary or general price-level changes in the costs of the factors of production. These ceteris paribus assumptions are implied in the simulation model, with the change in the total level of expense dependent marginally on the changes in the student mix.

Ultimate Use of the Simulation Model

Besides being a tool for estimating the resources needed in some future period to provide an environment for learning, the simulation model will give data on the number of classes needed for each course. To implement this least-cost plan, the students who enter the university must be scheduled to these classes and no more. If additional classes are formed simply because the schedule of classes was not properly constructed, then the plan developed by the simulation model will be violated and costs will be higher than planned or necessary.

Methods of scheduling now being developed give promise of being able to solve this problem. The problem is one of finding a schedule with a given number of classes, each limited to a certain number of students. The time table for the classes must be arranged in such a way that the students can enroll in the courses they select without two or more classes meeting at the same time, the staff members who are assigned to teach the classes can do so without two or more classes meeting at the same time, and the classrooms and laboratories can be used without exceeding the total number available or having more than one class meeting in the room at the same time. The simulation model will have reported the quantity of staff time needed to teach these classes, and presumably this amount will be available. This schedul-

ing technique will therefore implement the least-cost plan developed by the simulation model, assuming the physical plant is large enough to accommodate the number of classes required. If the latter condition is not met, then the number of students will have to be reduced or additional space provided.

Conclusion

The idea underlying all the details presented in Chapter III is that the "product" of the environment for learning is represented for analytical purposes by the number of classes. The expansion or contraction of cost is proportional to this quantity.

The input data have to be viewed in these terms for a meaningful analysis. The accounting information must be related to the operating period under study and not to either the preceding or following period. That is, the expenses must include only those incurred or assignable and not just paid during the period. For example, fringe benefits are usually paid in various installments that do not always coincide with the time the staff members perform their services. If the cost of fringe benefits is to be properly determined, the expense must be charged in the operating period being analyzed; should the payment not be made until later, "Accounts Payable" can be credited. Likewise income must represent only that which was earned and spent during the period. Student fees and overhead recoveries from contract research must be credited to income at the appropriate time, and not just when the cash payment is received. If contract research is paid in advance, the income must be credited in such a way that only the amount needed for the operating period is entered, with the remainder entered in a

balance sheet account appropriately named (e.g. "Funds Received but Reserved for Future Operations").

These statements simply describe accrual as contrasted with cash accounting. Both income and expense are needed in this analysis, because the only satisfactory response to the question, "How much does it cost?" must be another, "From whose point of view: the state, the student, the sponsor of research, the endowments of the institution, or from all sources?" Unless the second question properly defines the first, the answer can be misleading. Any response not based on accrual accounting may be in error.

Fortunately the data for the physical units descriptive of the output (i.e., the number of classes, the staff members employment terms, and the number of students registered in the university) can be assigned to one or another semester, quarter, or session. Some over-lap may exist between one semester and another, but an arbitrary decision can be made in such a way that the functional relationship between cost and production will not be distorted. The count of the number of students in the operating period must be related to class enrollments, and illustrations of a registration report and course enrollment report are included to show how one data source will produce statistics which accurately represents the student data.

The procedure described in Chapter III demands precision in accounting and processing data. The data requirements, however, are not impossible to meet (the accounting ideas have been known and practiced in most enterprises for many years). The methodology follows a simple logic that is in most cases self-explanatory. This system of uniting fiscal with production data will permit the analysis that is set forth in Chapter II to be made.

The discussion of the significance of the cost study procedure is not exhaustive of the various supplementary considerations that are relevant for understanding the economics of a university, but this chapter is included to point out some of the more obvious things that can be studied with the data.

Finally this technique for analysis provides a basis for making per-student cost comparisons, either inter-institutionally or intra-institutionally. Whatever per-student quantity is selected for comparison: per class, per course, per student's field of study, or per level of student, the reference is to an <u>average</u> cost per student. The calculation of this average locates a single point on an average cost curve. The comparison of this point with a second point on another cost curve becomes meaningless without knowing the shape of both curves such that comparisons are possible over the full operating range. Unless this comparison is made, the coincidence of two per-student costs at a given level of output is not indicative of cost in relation to production. At a slightly higher output, one case might have a substantial drop in the cost per student while the other might rise. The knowledge of this actual situation is highly relevant for planning the future. The analysis of the "building blocks", or classes, is one apparatus available to ascertain the facts - which is the rationale for this thesis.

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